Energy+Environmental Economics

Time Dependent Valuation (TDV) 2013 Base Standards

California Energy Commission
November 16, 2010

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Energy and Environmental Economics, Inc.

- San Francisco-based consulting firm since 1989
- Deep expertise in electricity sector
- Experienced in linking technical-economic analysis to policy decision-making and public process
- E3 worked on the 2005 and 2008 Title 24 TDVs

Agenda

- **Overview and Purpose**
- **Key Changes in 2013 TDVs**
- **Results Compared to 2008**
- **Methodology**
  - Electricity TDVs
  - Natural gas TDVs
  - Propane TDVs

Purpose & Principles of TDV

+ Purpose

- Create a metric to value energy efficiency based on ***when*** energy savings occur, reflecting the variations over time in the cost of energy production and delivery

+ Principles

- Rational and repeatable methods
- Based on hourly (or monthly) cost of energy, scaled to rates
- Seamless integration within Title 24 compliance methods
- Climate zone sensitive

Key changes to 2013 TDVs Compared to 2008

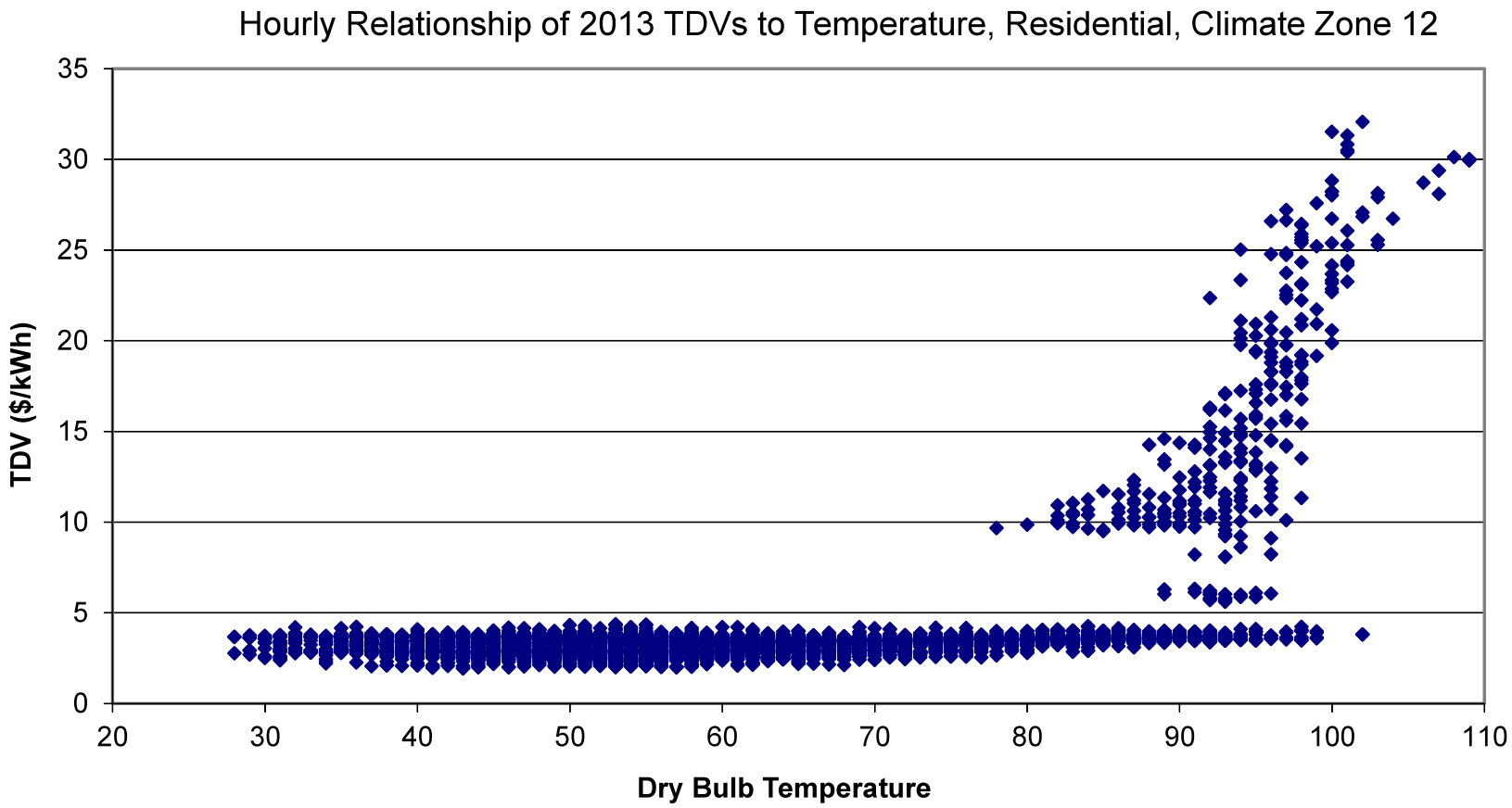
+ **Updates to all data inputs using recent public data**
  - Natural gas, CO2 price, retail rate forecasts
  - Wholesale electricity market price shapes
  - Avoided cost of transmission and distribution (T&D)
  - Avoided cost of capacity & ancillary services (A/S)
+ **Methodology improvements**
  - Statewide weather files correlated with hourly load shapes
  - Inclusion of the impacts of AB 32 Scoping Plan policies
  - Improved capacity cost methodology
  - Standardized treatment of avoided costs across utility service territories

Clarification Notes

- **2013 TDVs timeframe for economic analysis is 2011 – 2040**
  - Timeframe was developed prior to decision to release new standard in 2013
  - Analysis period could be updated to begin in 2013, but would have little impact on the results and would slow-down the standards process
- **All Net Present Value TDV costs are reported in 2011 year dollars**
- **2013 TDVs are reported in the 2009 Calendar-year format and correspond to 2009 typical weather year files**

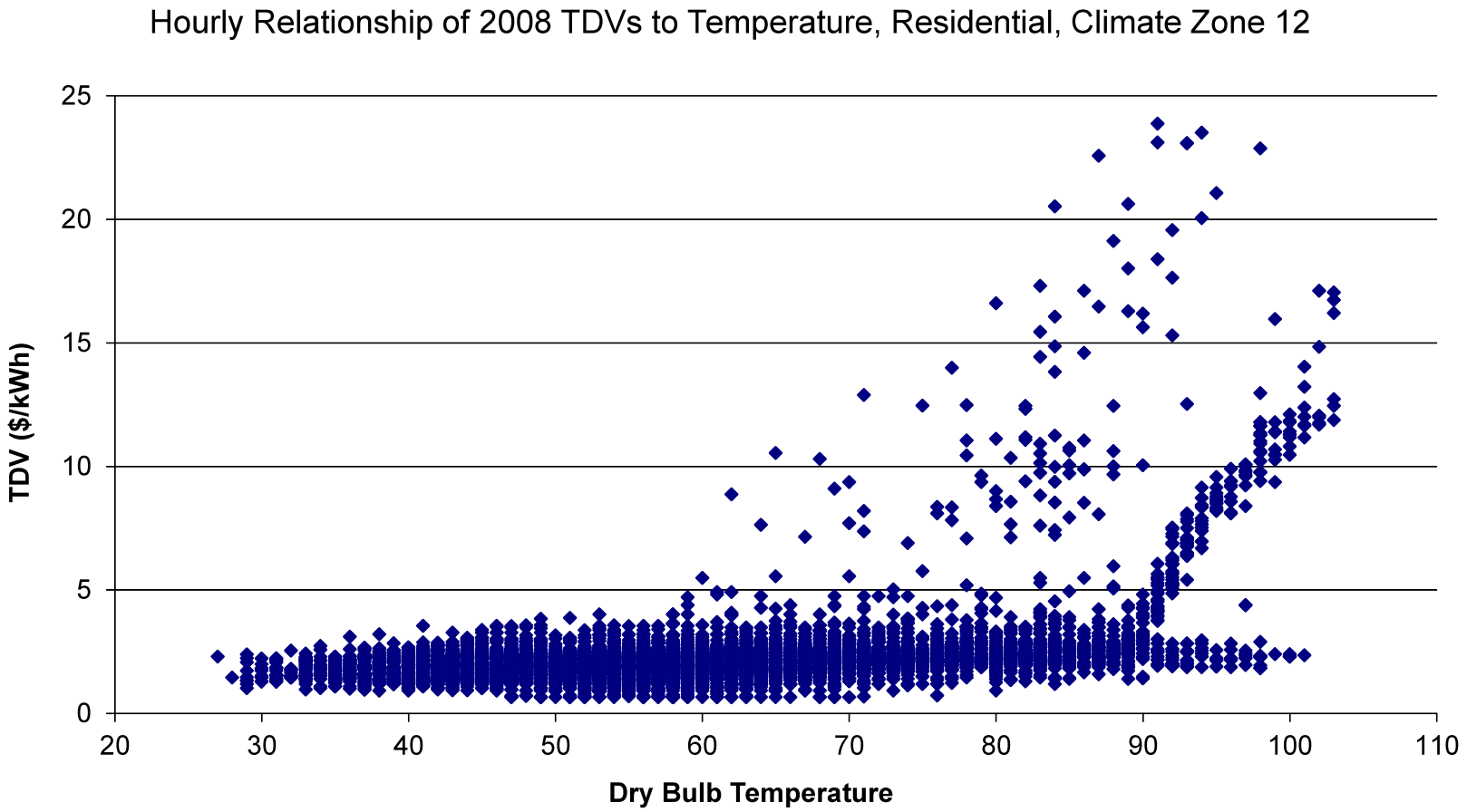
Correlation of Statewide Weather with 2013 TDVs

- **2013 TDVs show strong correlation between temperature and TDVs**

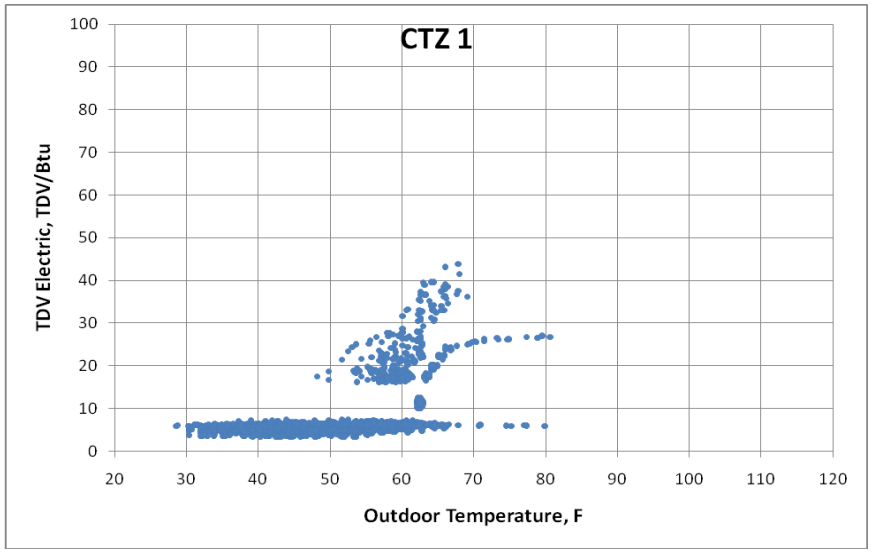


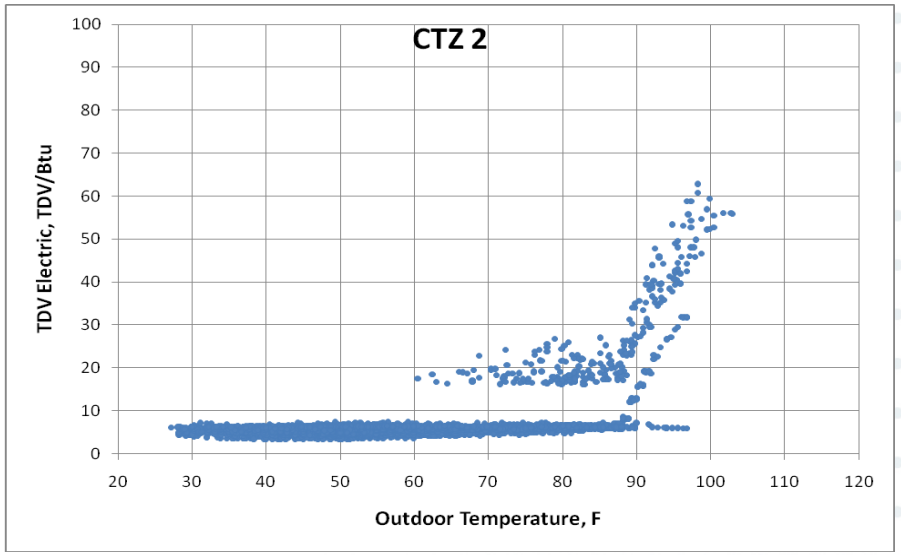
Correlation of Statewide Weather with 2008 TDVs

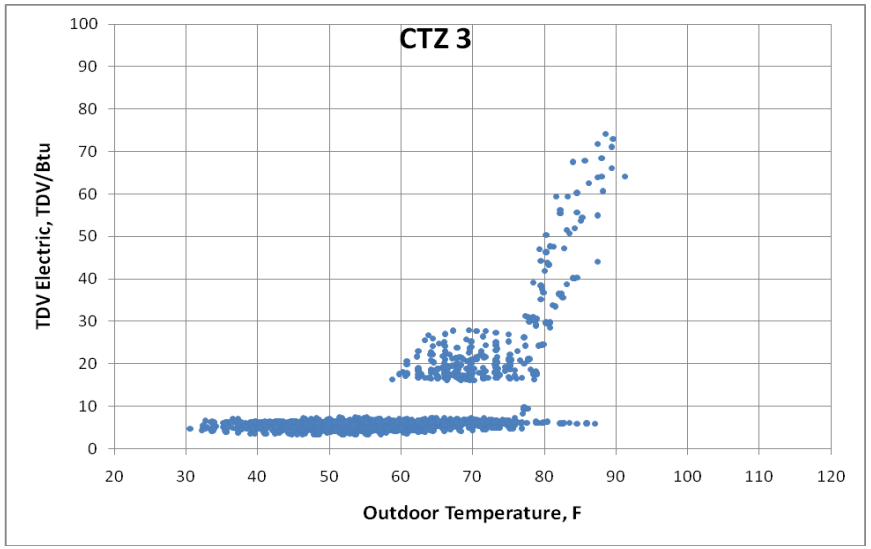
- **2008 TDVs show correlation between temperature and TDVs, but not as strong as 2013 correlation**

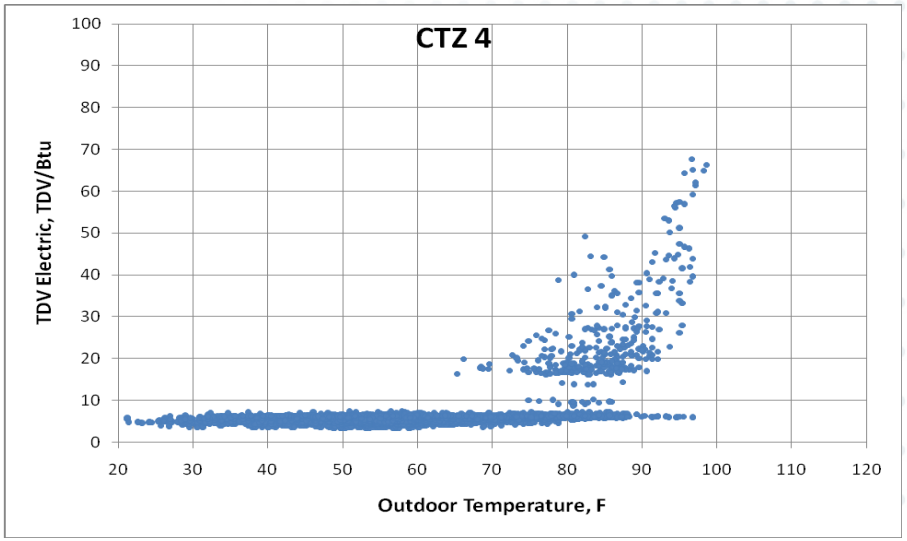


Correlation of Statewide Weather with 2013 TDVs





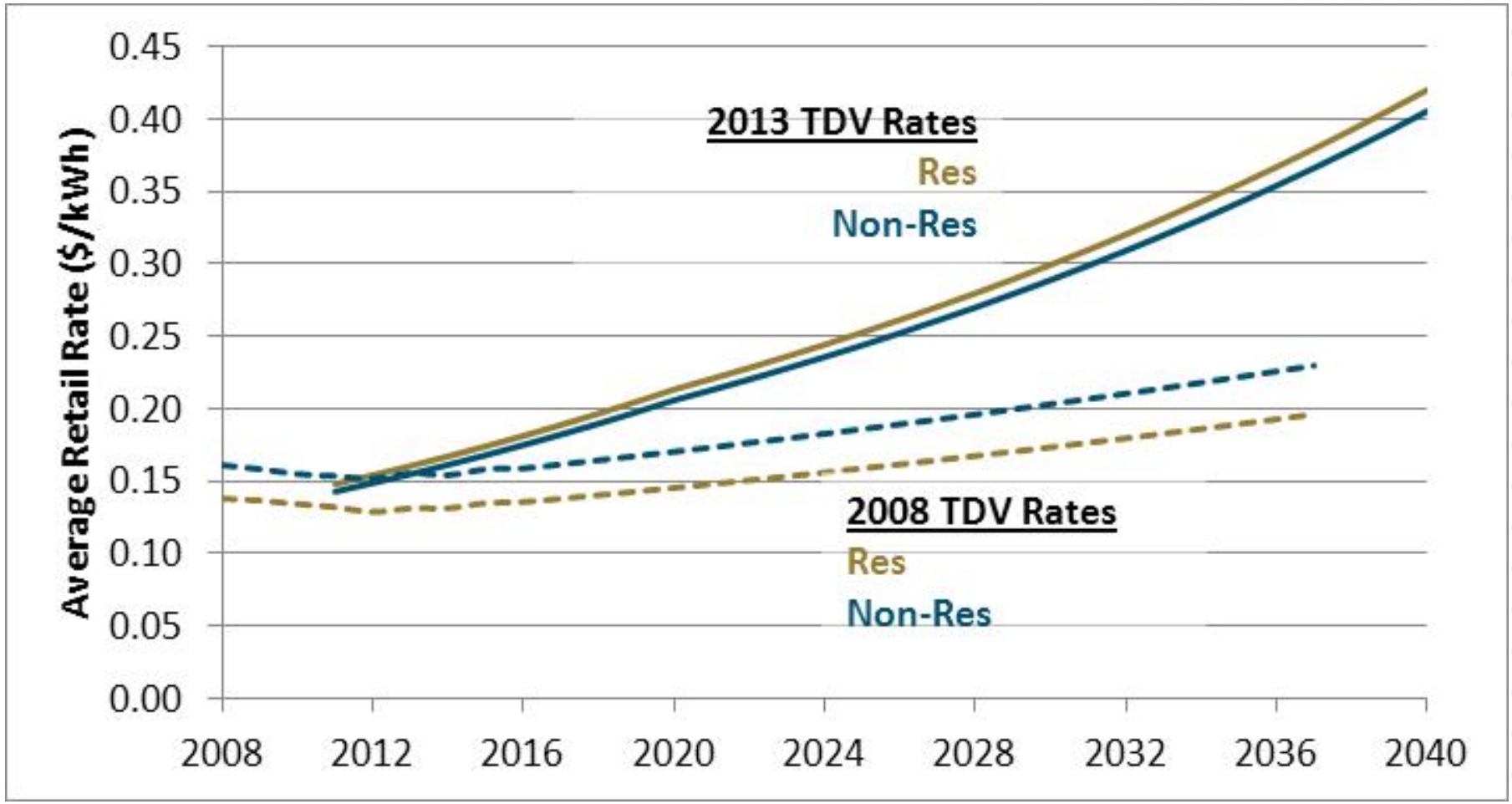




2013 TDVs Reflect Current State Policies and Trends

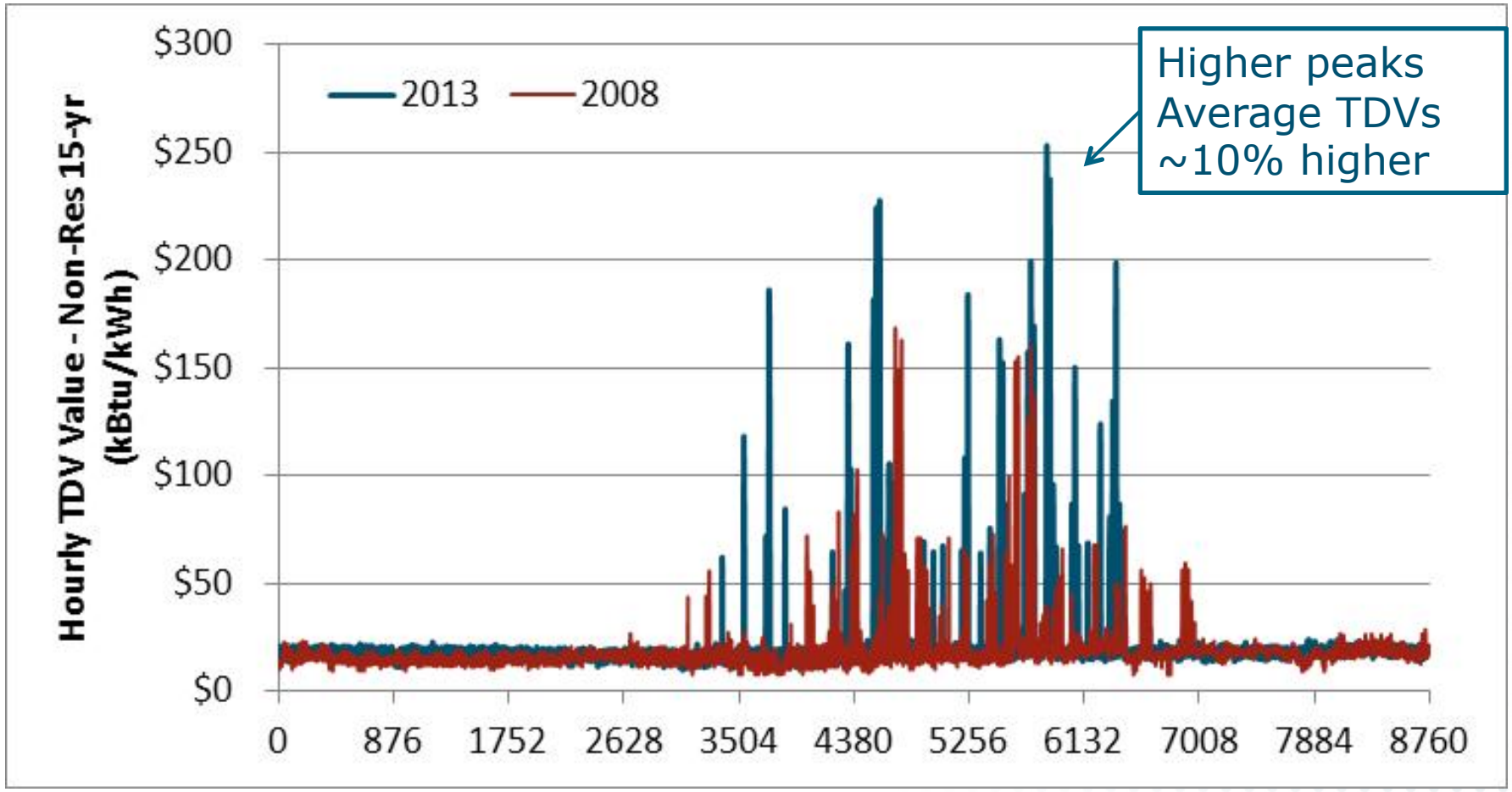
Input	Description
Retail rate escalation	Consistent with the E3/CARB 33% RES Calculator impacts through 2020 (higher than 2008 TDV forecast)
CO2 price	Synapse Consulting "Mid" forecast (higher than 2008 TDV forecast)
CO2 price policy	Assume future CO2 value is used to offset any impacts to retail rates. CO2 prices only affect the electricity market price shape, not price level.
Renewable Electricity Standard (RES)	Assume California meets a 33% RES by 2020. This affects retail rates and the market price shape of electricity based on "High Wind" case from CEC's "Electricity System Implications of 33 Percent Renewables" Study.
Other Policies	EE, Solar PV, CHP consistent with the AB 32 Scoping Plan goals and once-through cooling power plant regulations

Rate Forecast Comparison



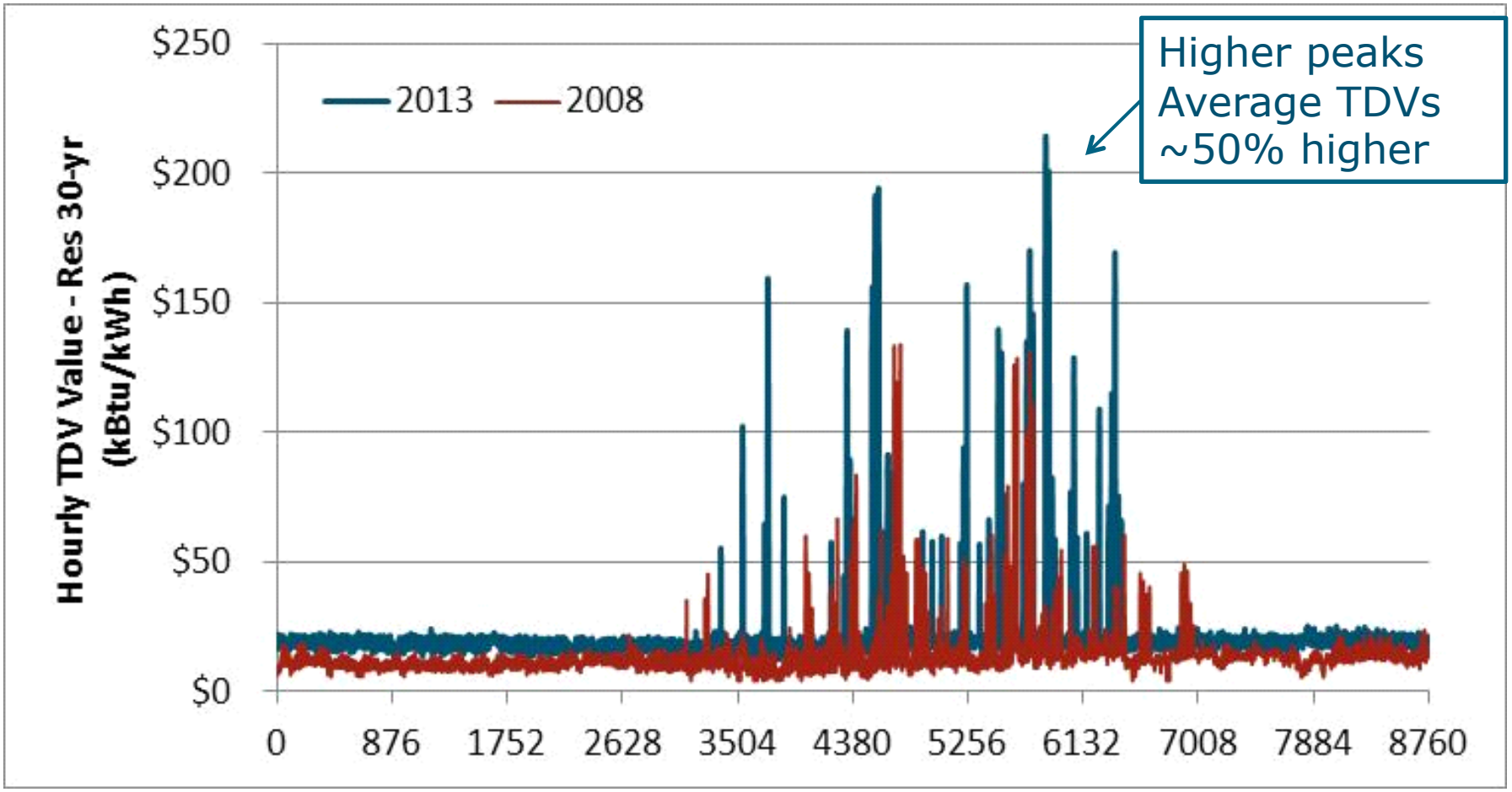
2013 TDV Comparison to 2008 – Non-Res (15-yr)

Climate Zone 2



2013 TDV Comparison to 2008 – Res (30-yr)

Climate Zone 2



Methodology

Three Basic Steps

1. **Develop hourly 15-year and 30-year forecasts of avoided cost of energy**
   - Residential and Nonresidential Electricity Costs
   - Residential and Nonresidential Natural Gas Costs
   - Residential and Nonresidential Propane Costs
2. **Calculate net present value (NPV) of cost stream**
3. **Convert NPV costs ($/unit energy) into TDV energy factors (kWh/kBtu for electricity)**

Step 1: Calculate Hourly Avoided Cost of Energy

Component	Description
Generation Energy	Estimate of hourly wholesale value of energy measured at the point of wholesale energy transaction
System Capacity	The costs of building new generation capacity to meet system peak loads
Ancillary Services	The marginal costs of providing system operations and reserves for electricity grid reliability
T&D Capacity	The costs of expanding transmission and distribution capacity to meet peak loads
Greenhouse Gas Emissions	The cost of carbon dioxide emissions (CO2) associated with the marginal electricity generation resource
Retail Rate Adjuster	TDV values are scaled to level equivalent to residential and nonresidential retail rate levels

Step 2: Net Present Value of TDVs

- **Net Present Value = value in current year dollars of a future stream of costs/benefits**
- **Energy efficiency measure lifetime is:**
  - **Residential: *30 years***
  - **Nonresidential: *30 years or 15 years***
- **The value of future energy savings is "discounted" to present dollars using a societal discount rate**
  - 3% real discount rate (at 2% inflation = 5% nominal)

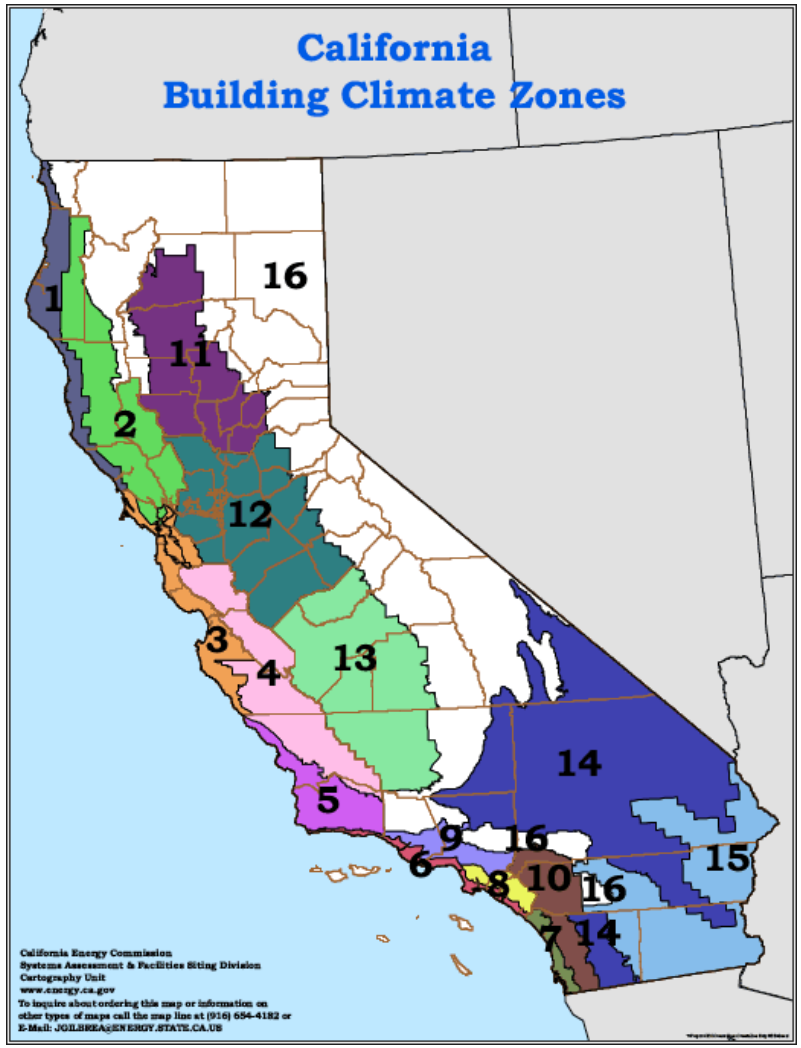
Step 3: Converting TDV Dollars to TDV Energy Factors

- **NPV costs ($/kWh) are converted to TDV energy factors (kWh/Btu) for two reasons:**
  1. Consistency with past performance compliance methods using source energy.
  2. TDV energy units make it less likely to mistake TDV savings for the actual dollar savings that any single building owner might realize from implementing the standard.
- **TDVs are converted to energy units using standardized factors based on cost of natural gas (same factors as used in 2005 and 2008, adjusted for inflation)**

TDV Conversion Factors NPV 2011$/kBtu (All Energy Types)		
	NPV (30-year)	NPV (15-year)
Low-Rise Residential	$0.1732	n.a.
Nonresidential & High-rise Residential	$0.1540	$0.0890

Electricity TDV Methodology

Climate Zones and TDVs



+ **Components of TDV values vary by climate zone. In 2013 TDVs, statewide averages of costs are used instead of utility-specific costs in ALL cases except line losses & market price shapes:**

Climate Zone	Majority IOU Territory
CEC Zone 1	PG&E
CEC Zone 2	PG&E
CEC Zone 3	PG&E
CEC Zone 4	PG&E
CEC Zone 5	SCE
CEC Zone 6	SCE
CEC Zone 7	SDG&E*
CEC Zone 8	SCE
CEC Zone 9	SCE
CEC Zone 10	SCE
CEC Zone 11	PG&E
CEC Zone 12	PG&E
CEC Zone 13	PG&E
CEC Zone 14	SCE
CEC Zone 15	SCE
CEC Zone 16	PG&E

* CZ7 uses SCE market price shape

More Details: Components of Avoided Cost of Electricity

Component	Basis of Annual Forecast	Basis of Hourly Shape
Generation Energy	Combination of market forwards through 2014 and a long-run forecast of California gas prices through 2040	Energy Commission production simulation dispatch model results using 2012 and 2020 test years
System Capacity	Fixed costs of a new simple-cycle combustion turbine, less net revenue from energy and AS markets	Hourly allocation factors calculated as a proxy for rLOLP based on loads from production simulation dispatch model results
Ancillary Services	Scales with the value of energy	Directly linked with energy shape
T&D Capacity	Survey of investor owned utility transmission and distribution deferral values from recent general rate cases	Hourly allocation factors calculated using hourly temperature data
Greenhouse Gas Emissions	Synapse Mid-Level carbon forecast developed for use in electricity sector IRPs	Directly linked with energy shape based on implied heat rate of marginal generation, with bounds on the maximum and minimum hourly value

Correlation of Temperature to Price

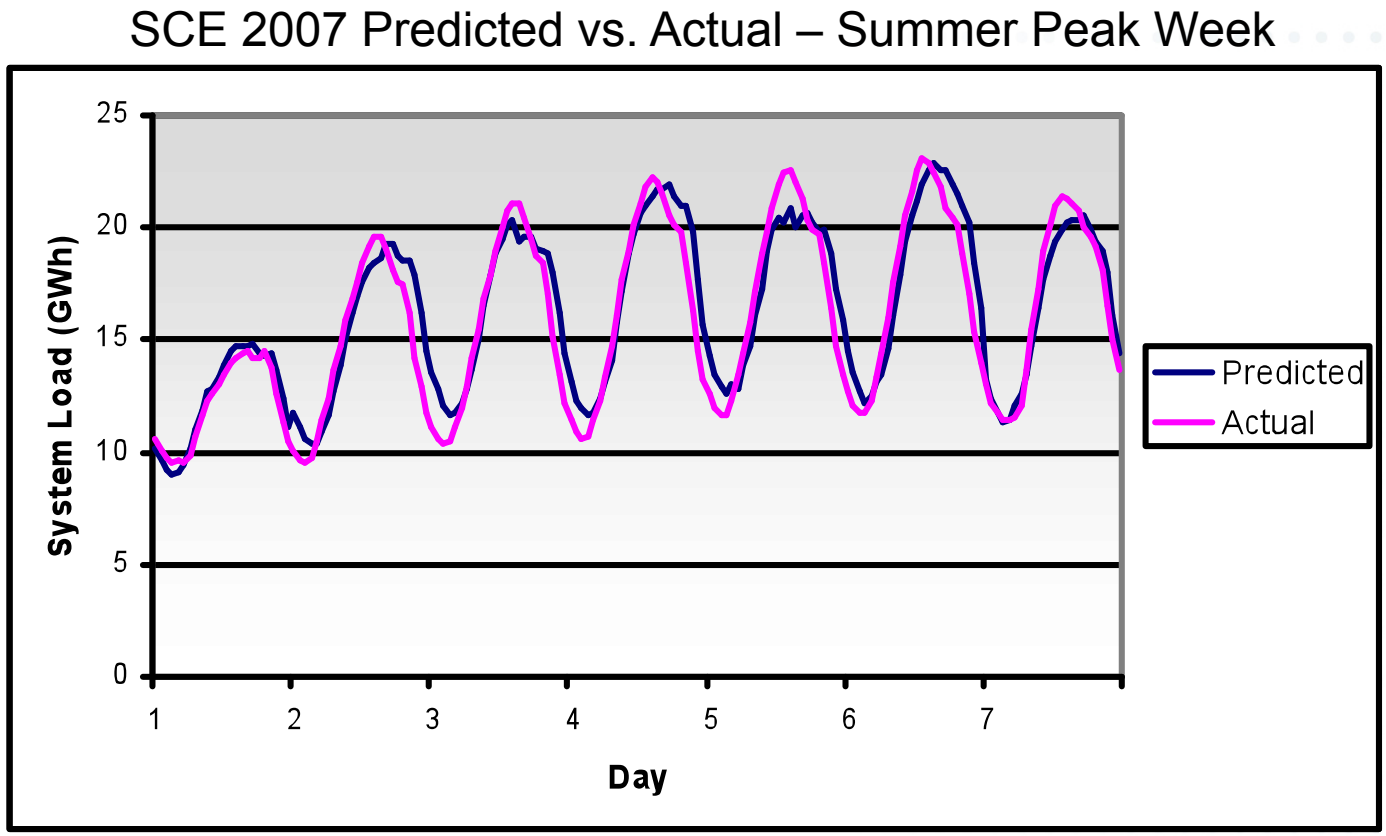
- Hourly market prices are developed using the CEC's production simulation dispatch model
- E3 developed 18 new load shapes by CA region for use in the dispatch model which are correlated w/ Title 24 typical weather year data
- This ensures that TDV market prices are correlated with Title 24 weather files
- E3 used statistical analysis and regression techniques with historical hourly temperatures, historical hourly loads and Title 24 typical weather year data to generate regional "typical" load shapes

Correlation of Temperature to Price Cont.

- **Regression analysis approach accounts for:**
  - Weather effect
    - dry bulb temperature, dew point temperature
    - cooling and heating degree hours, 3-day lagged cooling and heating degree days
  - Time-of-use effect (hour, day, month, holidays)
  - Skewness of load data (hourly distribution has long tail)
  - Peak loads (secondary regression captures peak hours for temps above 75°F)
  - Load growth (data are normalized for peak load)

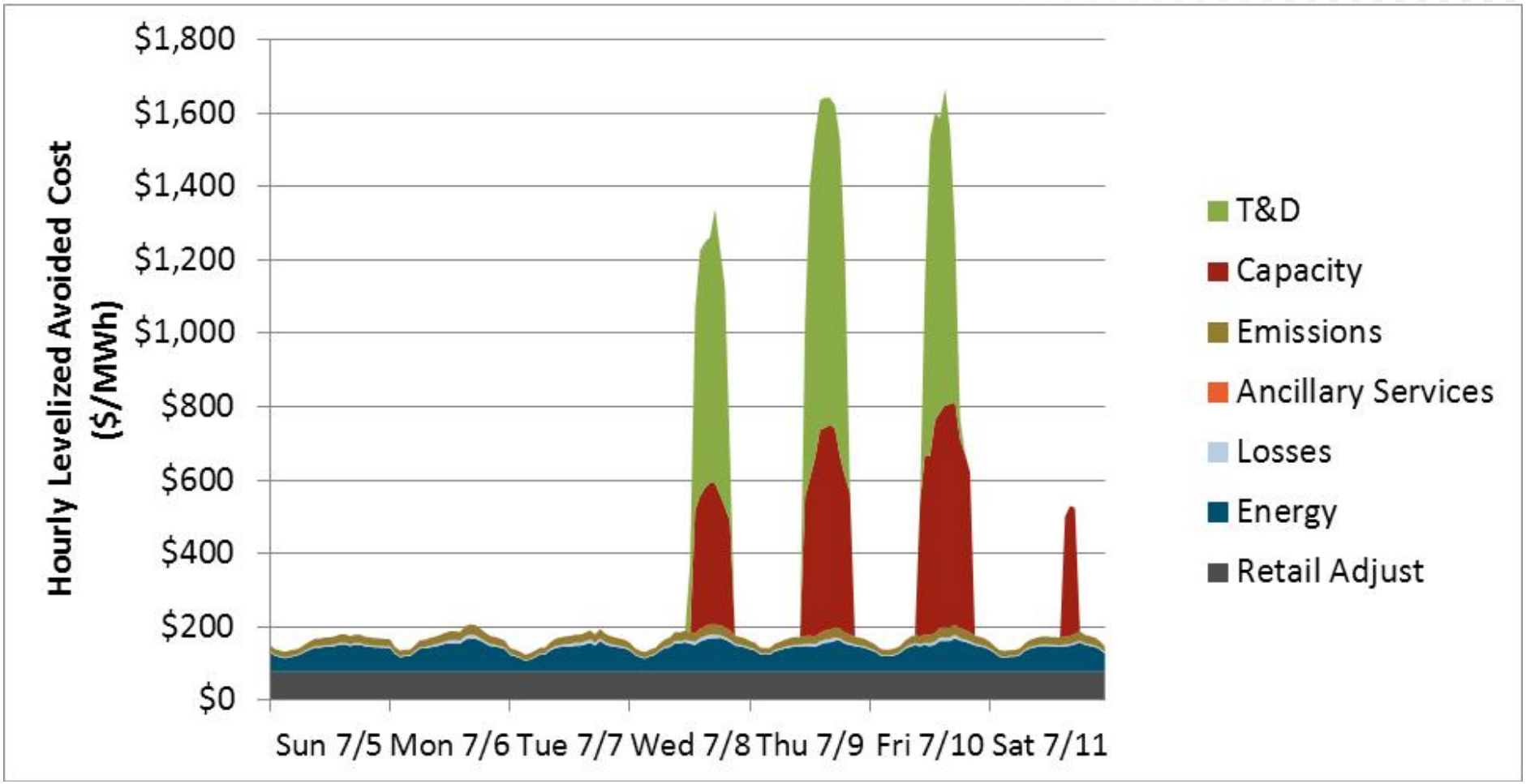
Correlation of Temperature to Price: Example Result

- **Statistical correlation between hourly historical loads and hourly historical weather produces robust results**



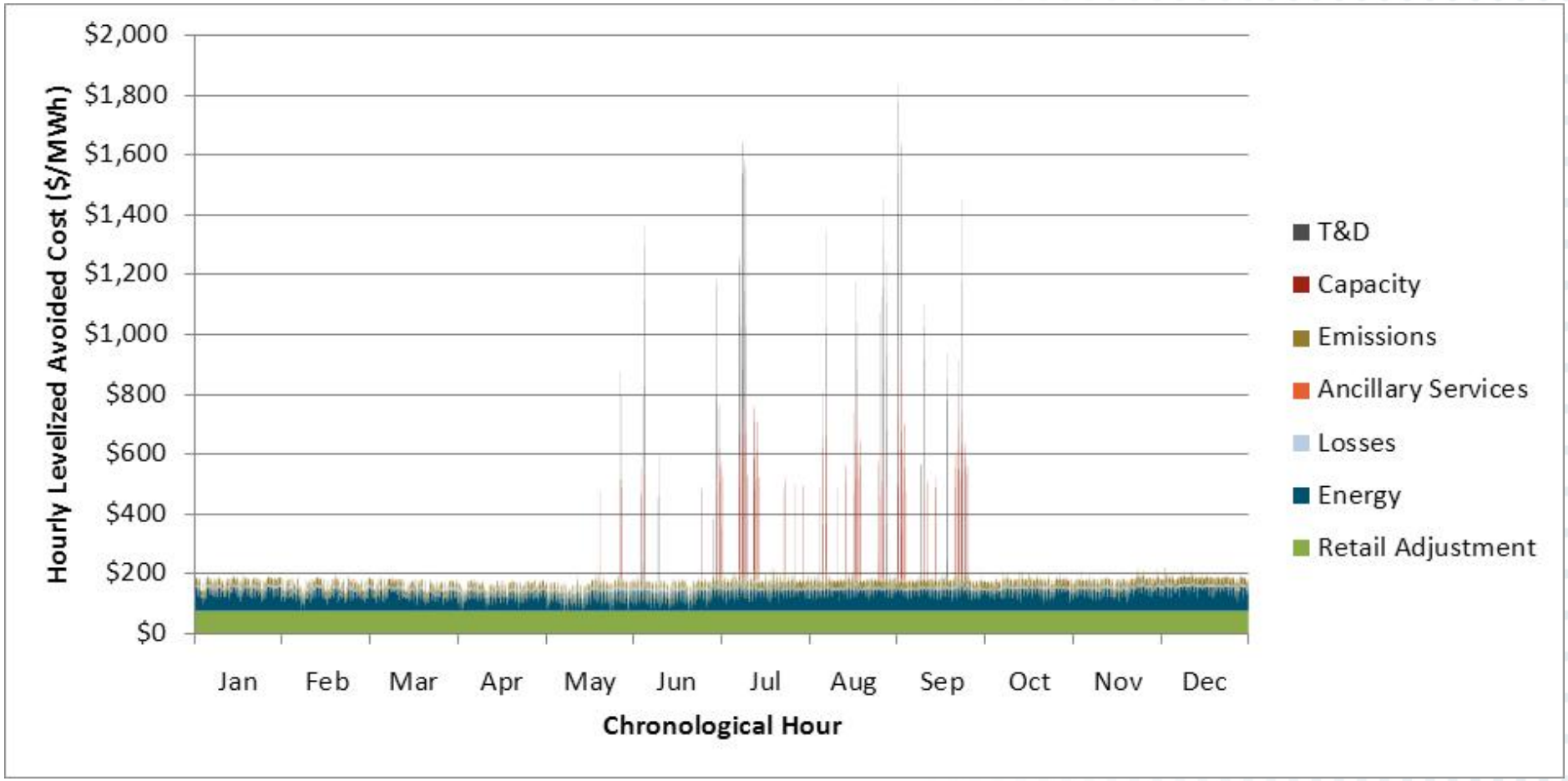
Hourly Electricity Avoided Cost – One Week

Climate Zone 2

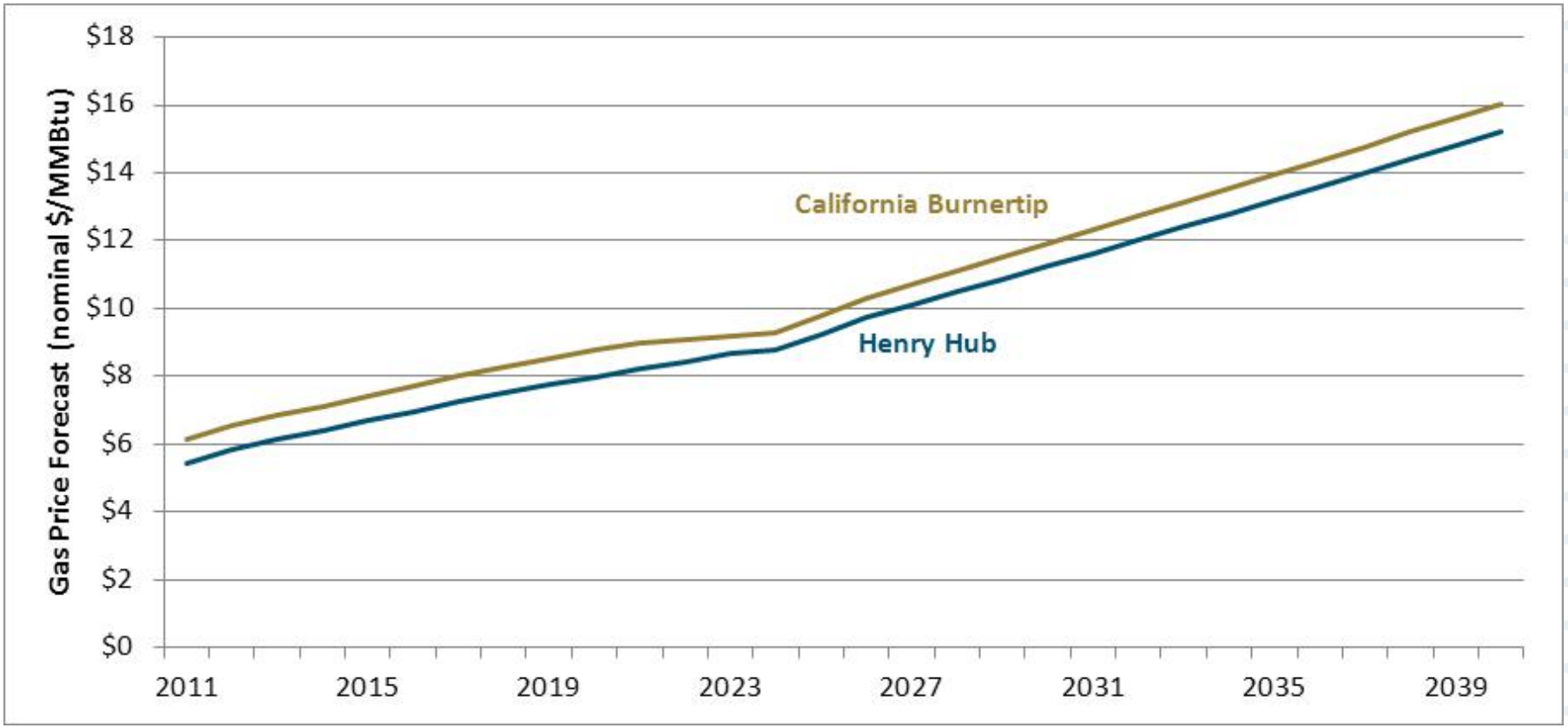


Hourly Electricity Avoided Costs – One Year

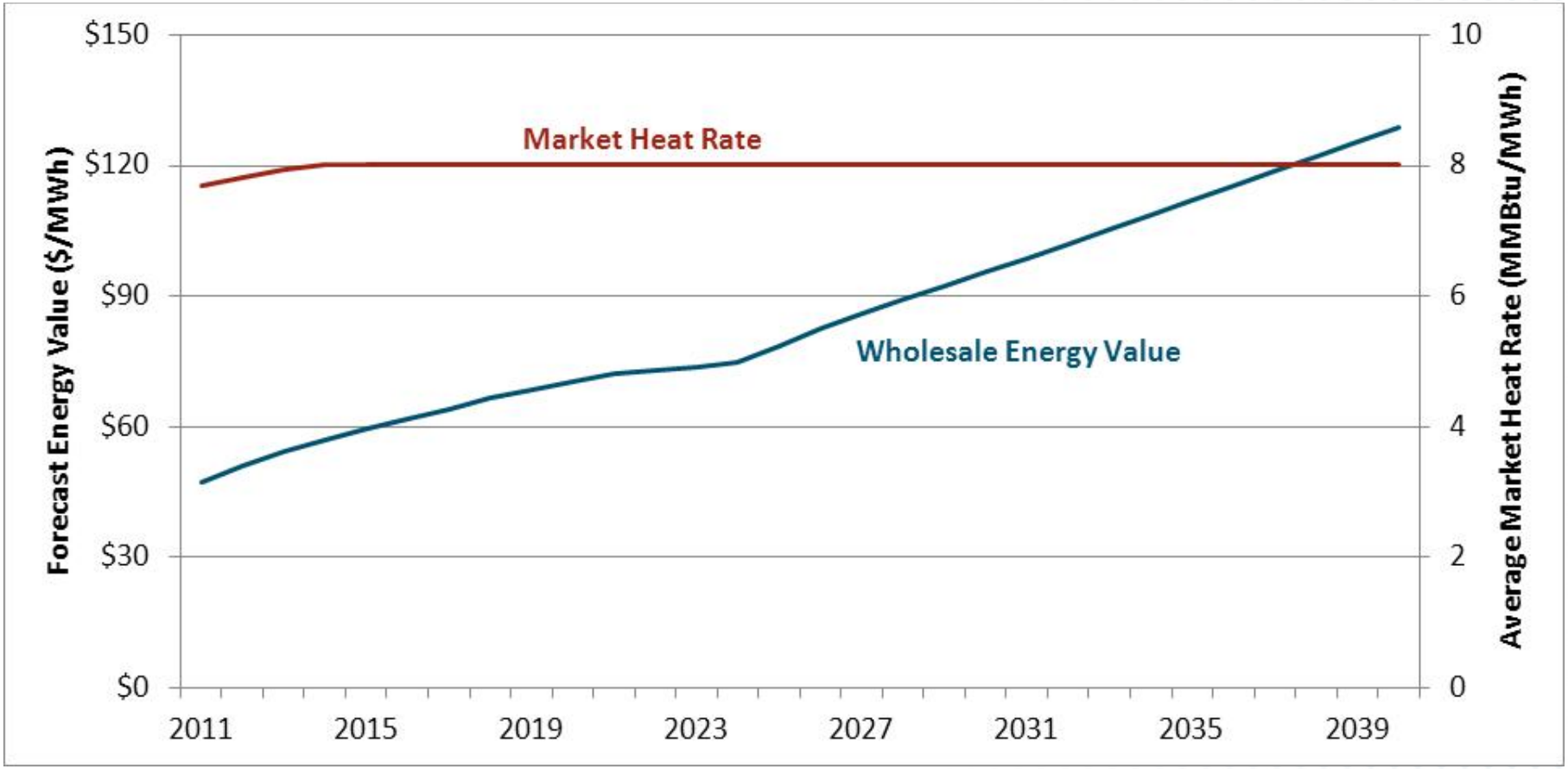
Climate Zone 2



Natural Gas Price Forecast

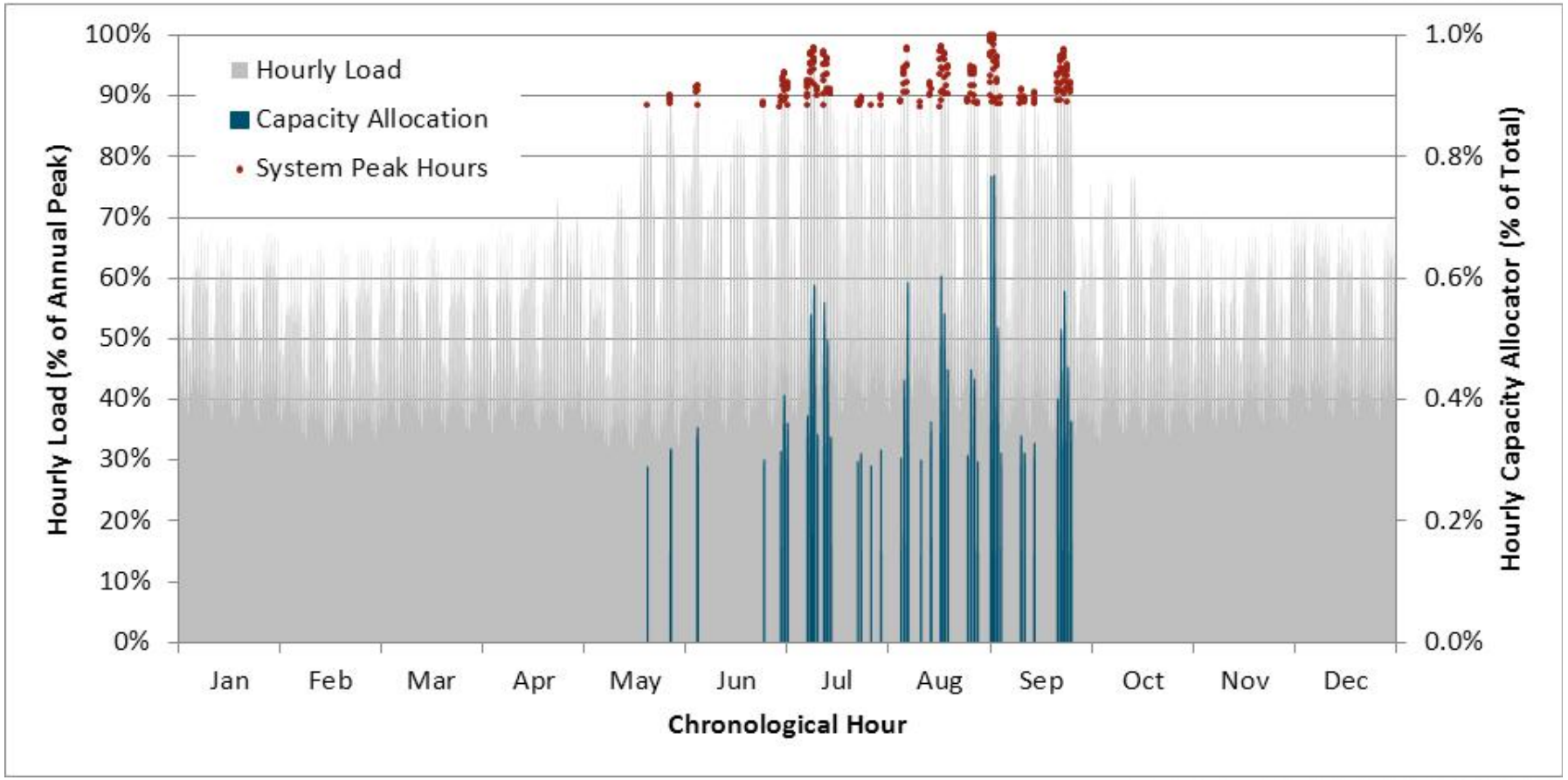


Wholesale Energy Forecast



Allocation of Generation Capacity Value

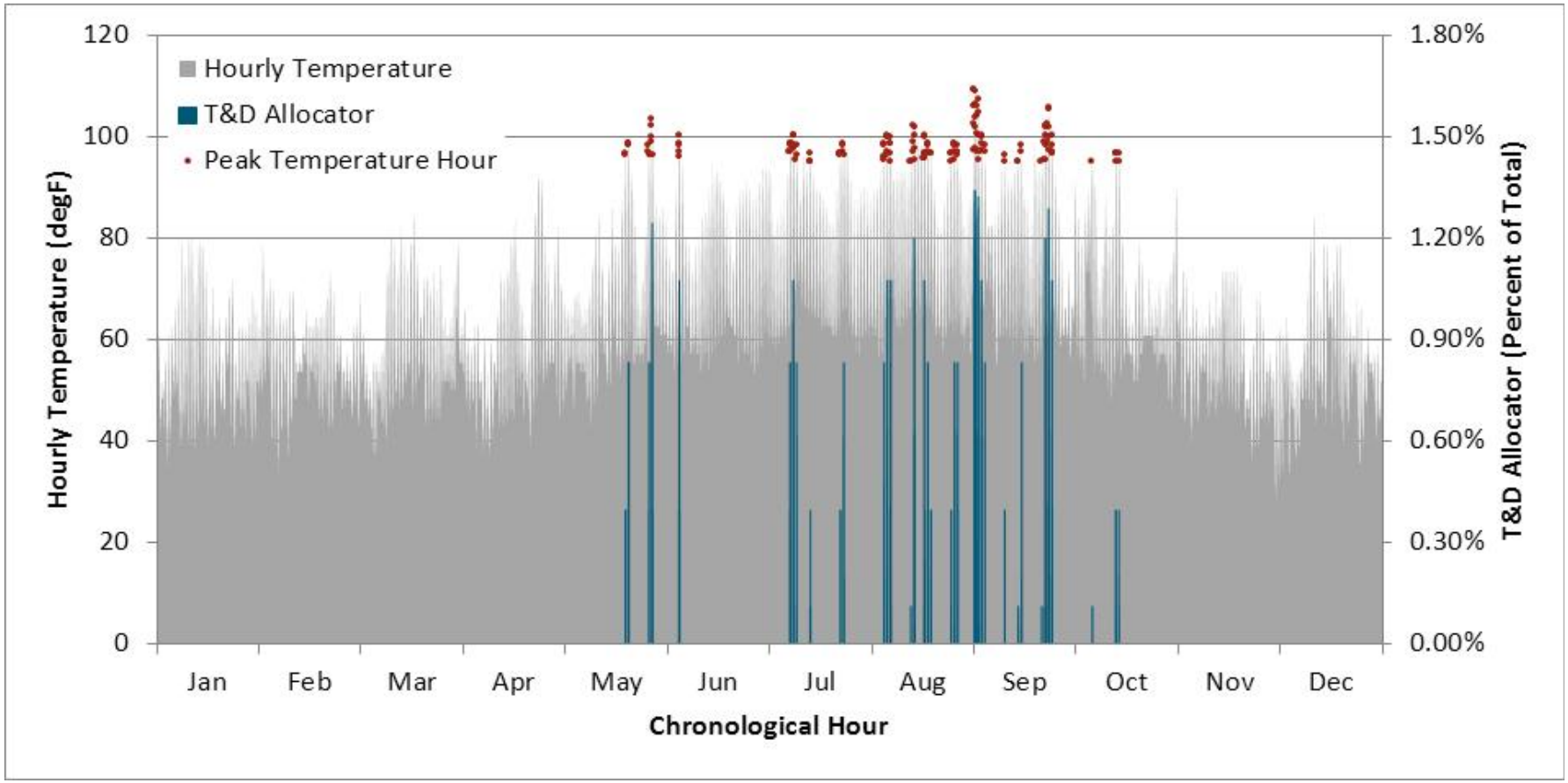
+ **Capacity costs are allocated based on hourly loads**



Climate Zone 2

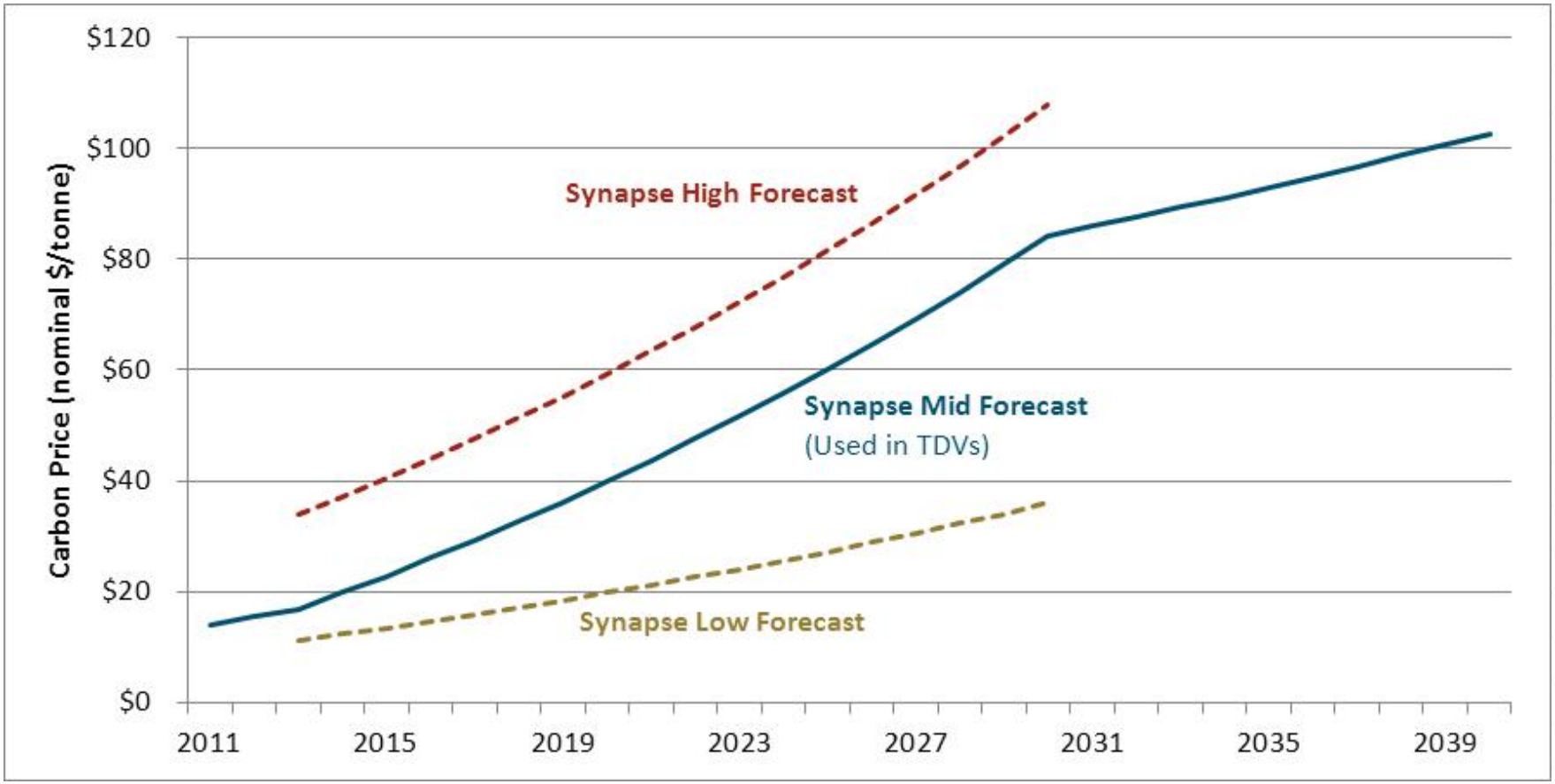
Allocation of T&D Capacity Value

+ **T&D costs allocated based on hourly temperatures**

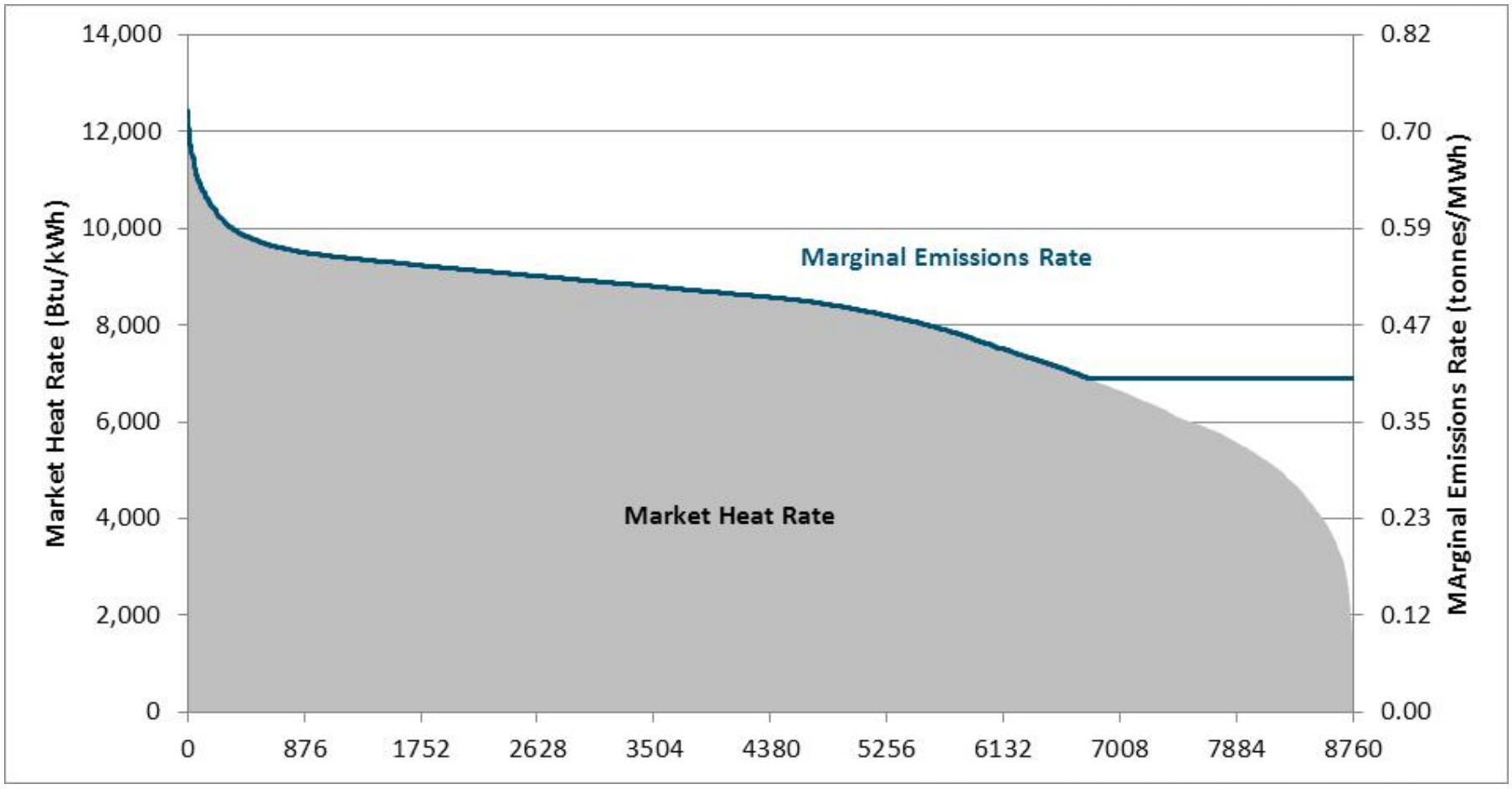


Climate Zone 2

CO2 Price Forecast

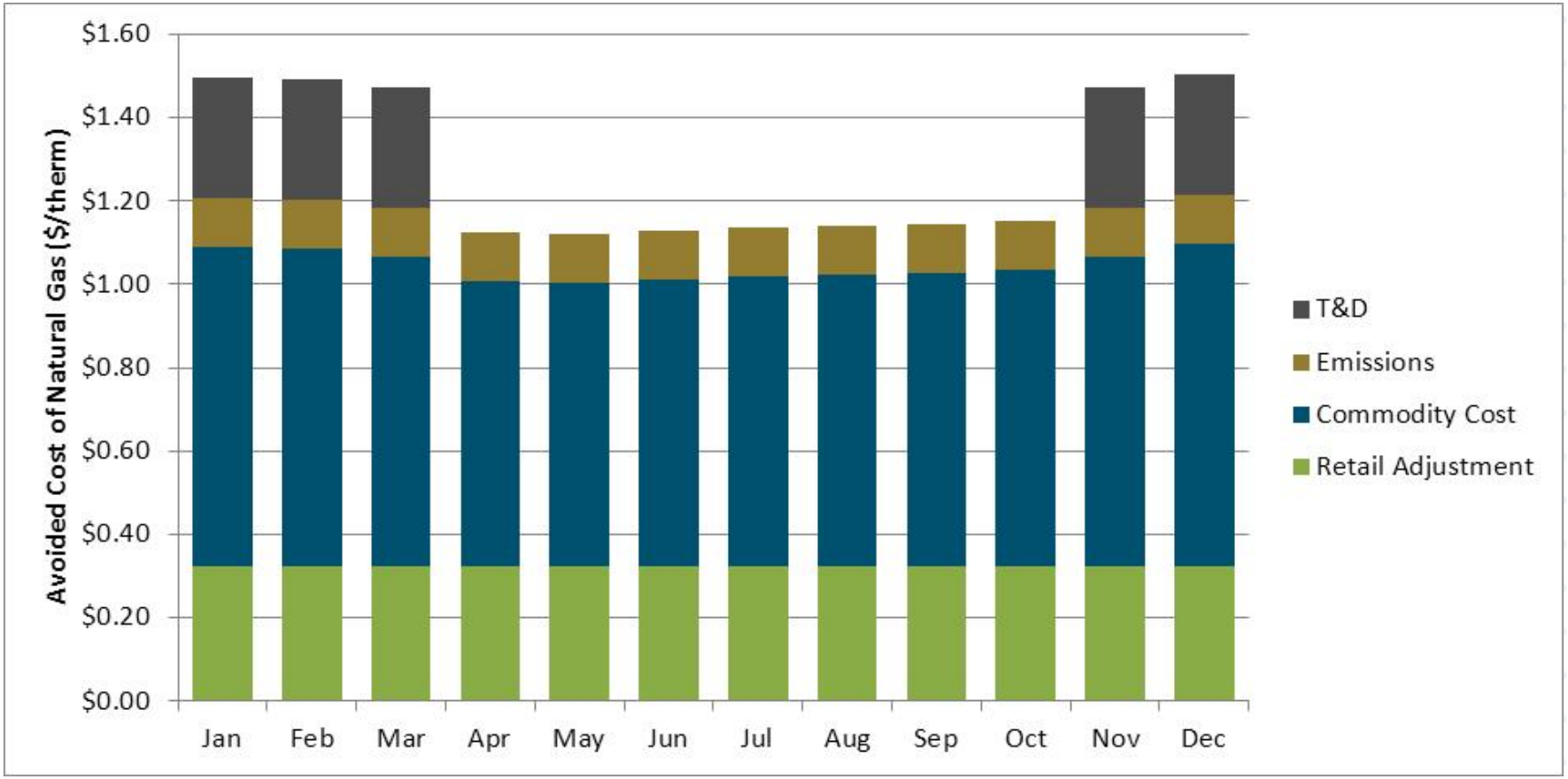


Derivation of Hourly Emissions Rates for CO2 Cost Allocation

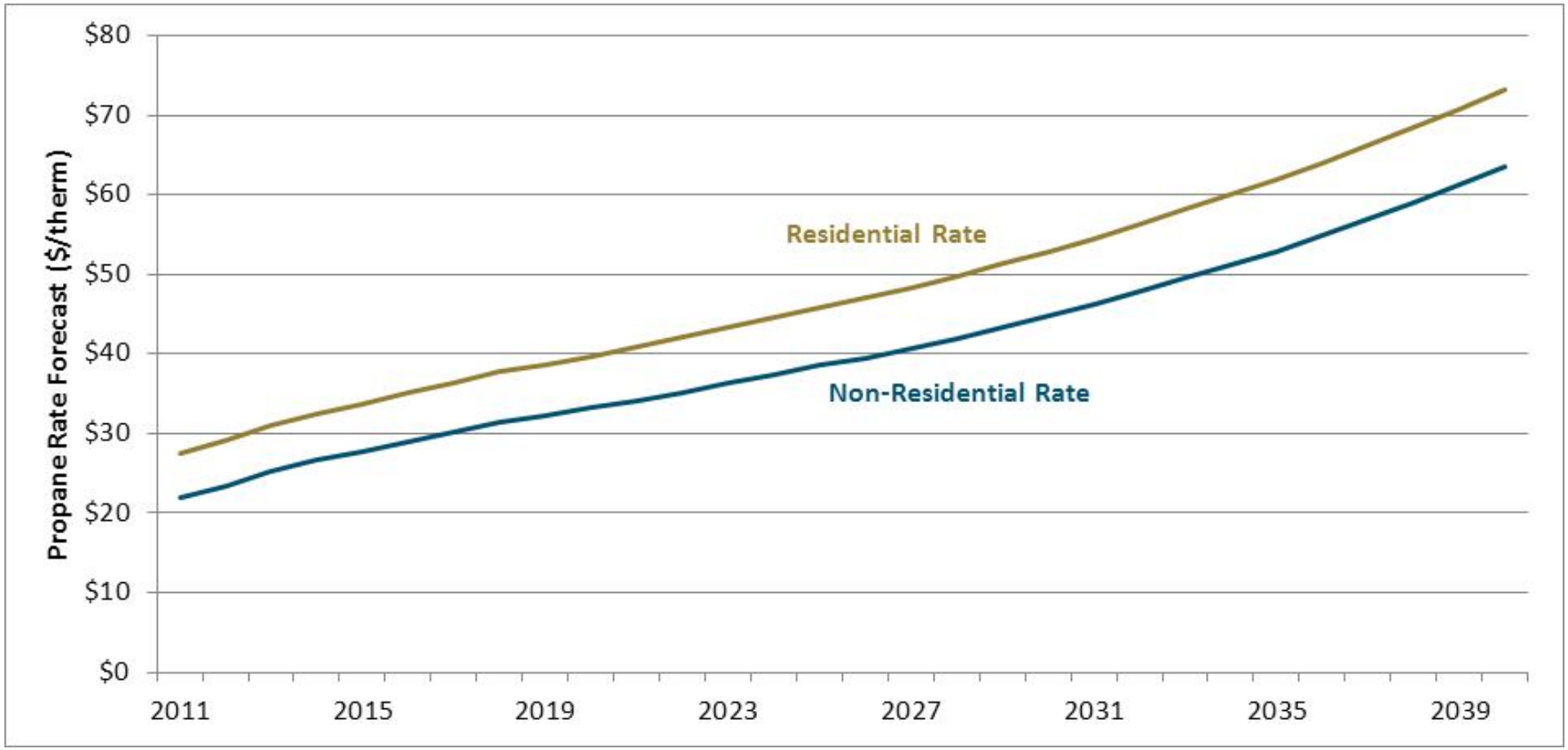


Natural Gas and Propane TDVs

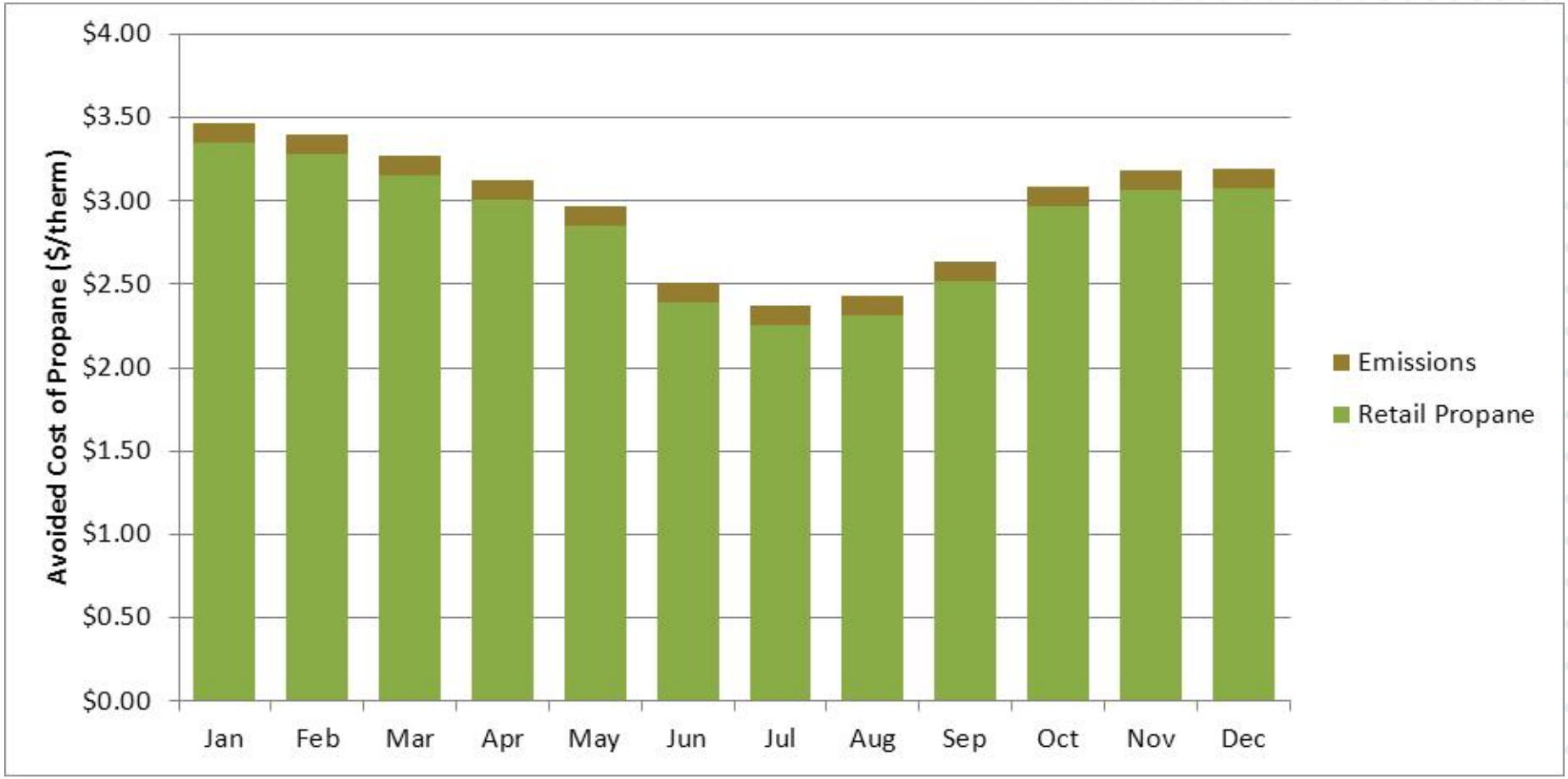
Monthly Natural Gas Avoided Costs



Propane Price Forecast



Monthly Propane Avoided Costs



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Time Dependent Valuation (TDV)

Proposed 2013 Reach Standards

California Energy Commission
November 16, 2010

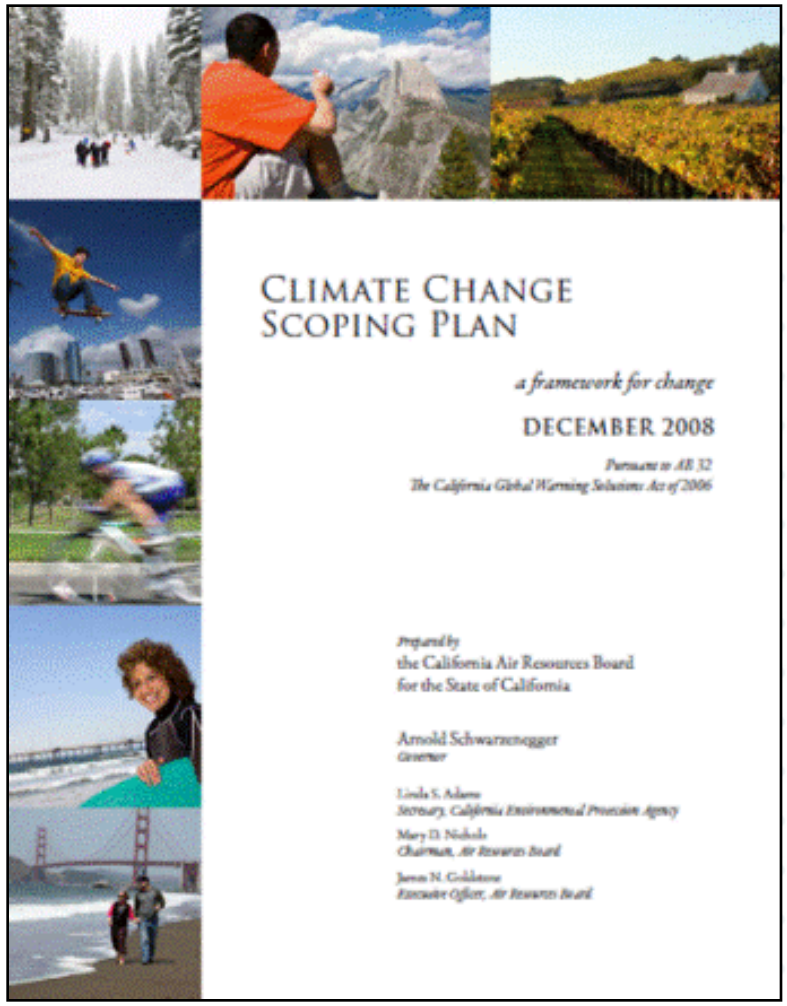
Snuller Price

Agenda

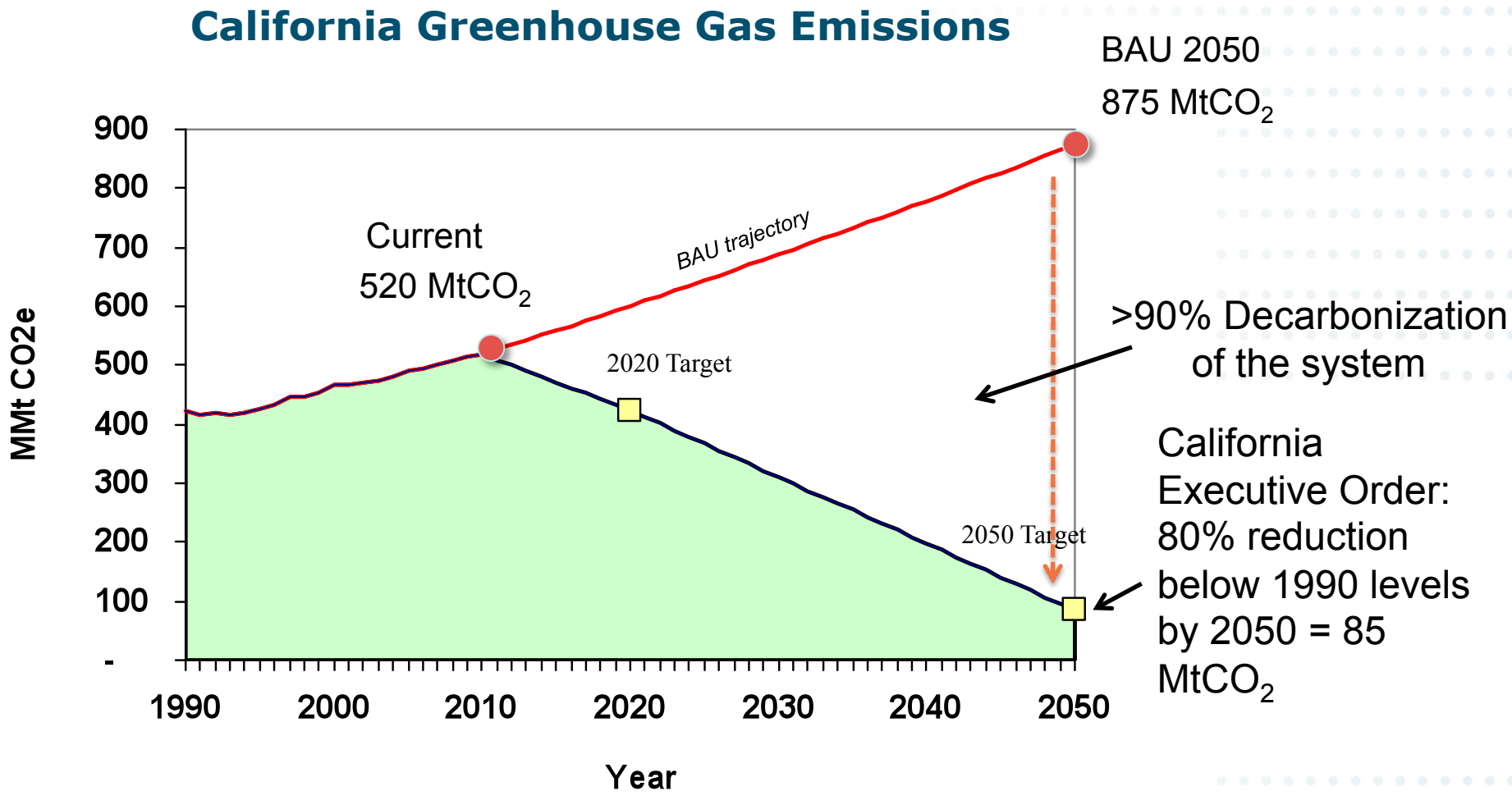
- **Purpose of Developing Reach TDVs**
  - Create more aggressive Title 24 standards for optional adoption by local jurisdictions and/or building designers
- **The Policy Context**
- **Proposed Reach I Standard**
- **Proposed Reach II Standard**
- **Discussion**

Reductions in Greenhouse Gas Emissions – A Policy Priority

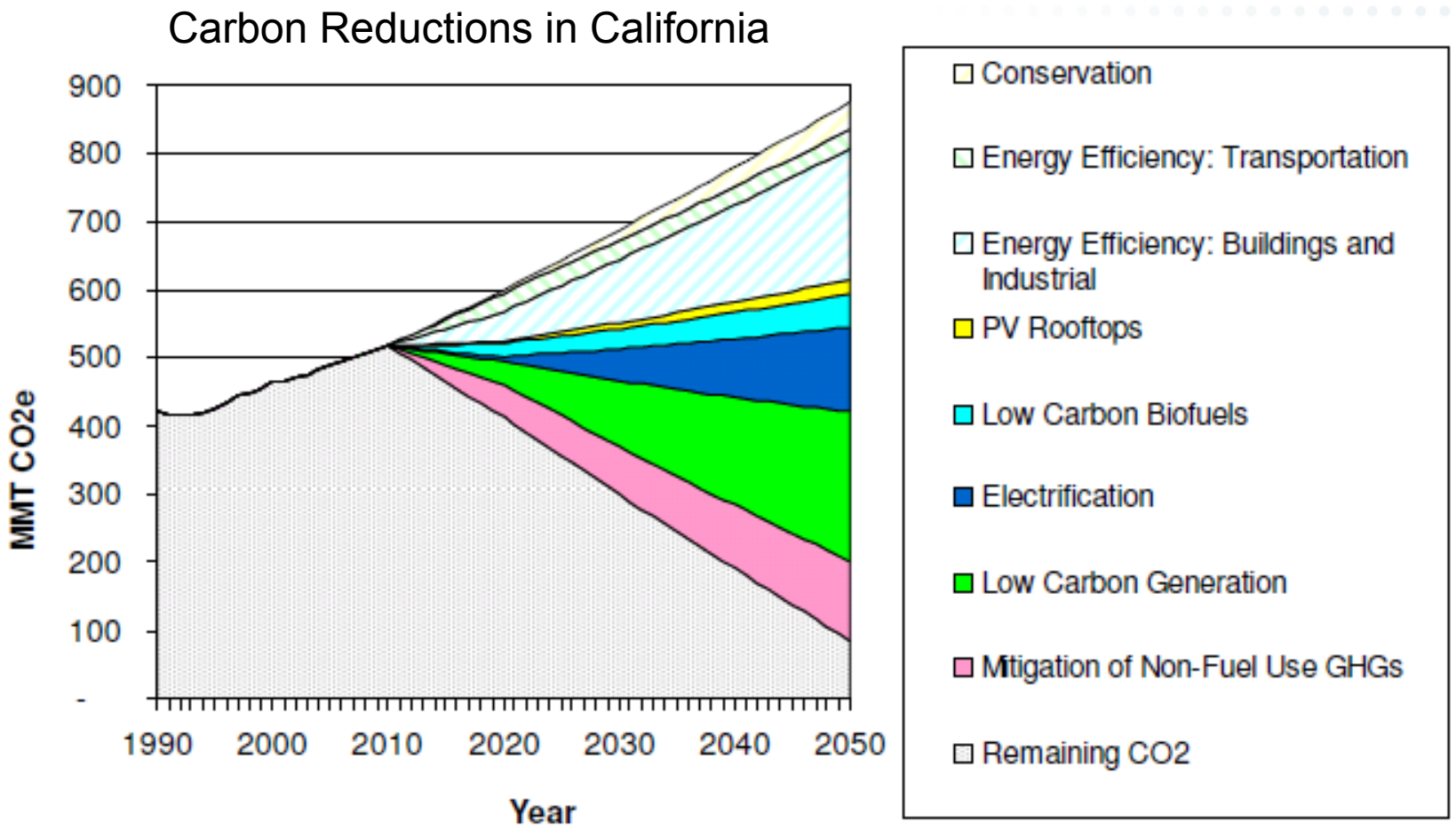
- State law (AB 32) requires emissions to reach 1990 levels by 2020
- California buildings represent over 20% of statewide GHG emissions
- Building standards are an important component of California's strategy to reduce greenhouse gases



The Long-term Challenge: >90% Decarbonization of the Entire Economy



Energy Efficiency is a Critical for Deep Reductions in Greenhouse Gas Emissions



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Source: Energy and Environmental Economics, Inc. 2009

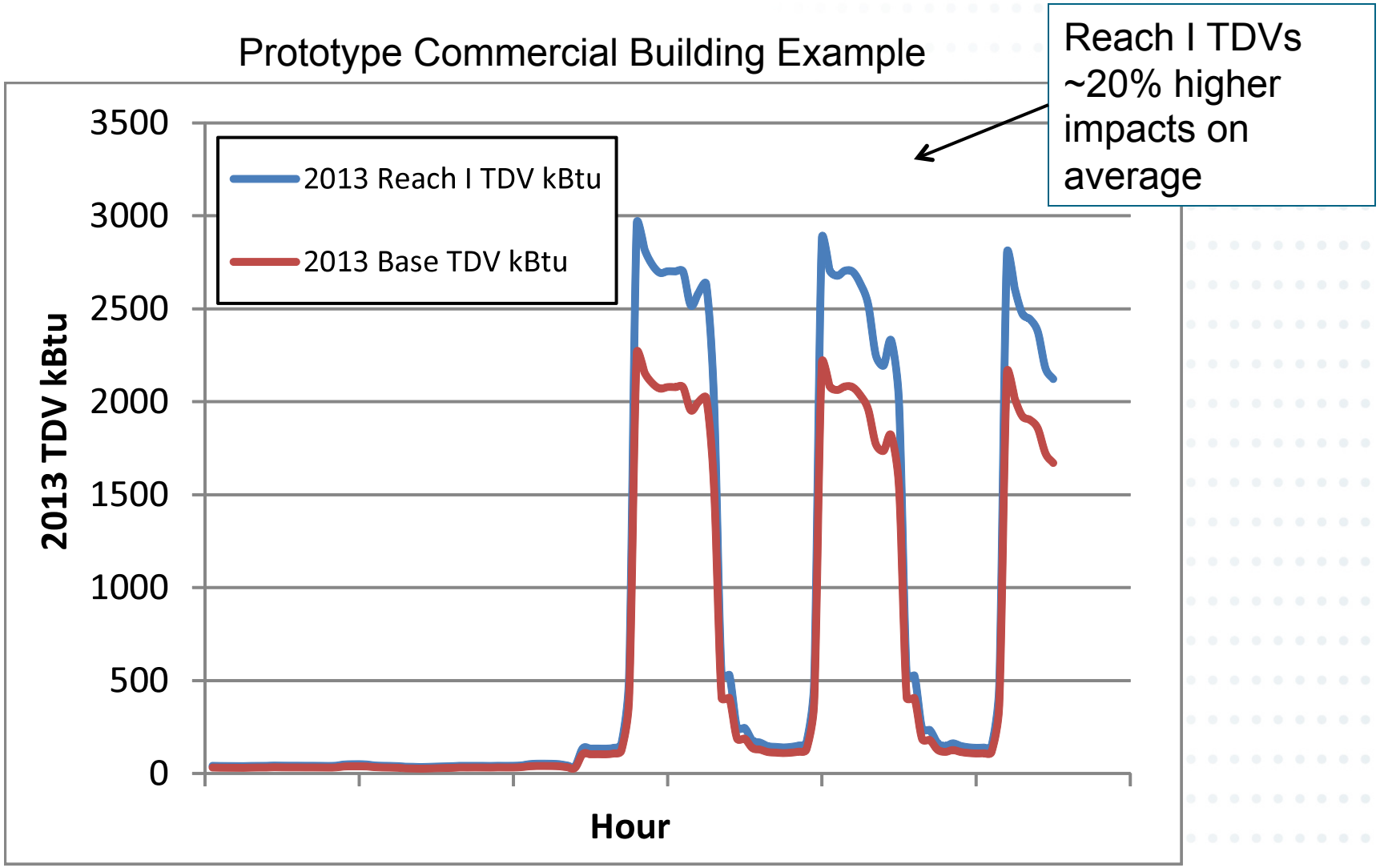
Conceptual Design of Proposed Reach Standards

- **Base TDV: "Current Policy"**
- **Reach I: "A Carbon Constrained World"**
  - *Reflects a greater societal emphasis on achieving greenhouse gas reductions, consistent with a goal of reducing GHG emissions 80% below 1990 levels by 2050.*
  - *Economics are based on 'equal sharing' of costs to reduce carbon with future generations*
- **Reach II: "Zero-Net Energy Ready Buildings"**
  - *Reflects a commitment to taking responsibility for solutions to the greenhouse gas problem in this generation, rather than sharing the burden with future generations by building zero-net energy ready buildings – everything but the self-generation*

Two Proposed Changes: Reach I A Carbon Constrained World

1. **Higher CO2 Emissions Price, layered on top of retail rate adjustment**
   - Base TDVs use a "market price forecast" for CO2 prices
     - Increases from $14/ton to $57/ton (in real 2010$)
   - Reach I TDVs would use a "societal value" on CO2 reductions
     - $73/ton each year (in real 2010$)
2. **Lower discount rate – 0% real discount rate**
   - Base TDVs use a 3% real societal discount rate
   - Reach I TDVs would use a 0% real discount rate: Values the future equally with the present

Comparing Base TDVs to Reach I



Reach II: Zero-Net Energy Ready Buildings

- **Principle is to include all energy efficiency measures needed for a ZNE building, EXCEPT for self-generation**
  - Self-generation can be added at discretion of the builder
  - Cost-effectiveness of solar electric options is being evaluated at Commission
- **Goal: identify the suite of measures that would lead to a 'least-cost' path to a ZNE building**
- **In practical terms, this means designing high-performance buildings that include a suite of energy efficiency measures that cost less than rooftop solar PV (~$0.28/kWh, depending on assumptions and installation)**

Implementing Reach I & Reach II

- **There are a number of possible implementation paths which Commission can decide between**
- **Prescriptive and ACM approaches could be the same as those used for the base standard, except…**
  - For Reach I use higher Reach I TDV values
  - For Reach II use cost of self-generation
- **Implications are being evaluated, considering for example…**
  - Interactive effects between measures, integration of passive features, and data availability on higher cost EE measures
- **Your thoughts and feedback are requested!**

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Thank You

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